Space Weather Technical Forecast

Issued on Monday, 27 May 2024 at 13:02 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: M-flares expected with a chance of isolated X-flares, with the return of the two previous large sunspots. Mostly quiet to unsettled geomagnetic conditions expected.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Activity is high with peak flare an X2.8 at 27/0708UTC from over the southeastern limb, likely in association with ex-AR3664 which is expected to rotate onto the visible disc within the next 24 hours, with its magnetic canopy and associated magnetic looping visible in SDO imagery. Analysis of the region, once it rotates onto the visible disc, will be necessary to determine if it has retained its full complexity from last rotation. There are eight numbered regions with the most notable being AR3691, likely ex-AR3663, in the northeast. AR3691 comprises of two delta spots: a large one at its centre and a smaller one to the northwest. Across the rest of the disc, the regions remain smaller and simpler.

A filament eruption to the southwest occurred around 27/0150 UTC, producing a narrow CME that is currently undergoing ENLIL analysis. However, this CME is unlikely to have an Earth-directed component. Additionally, a large and fast CME occurred from over the eastern limb in association with the X2.8 flare this morning, this is awaiting analysis and is not directed towards Earth. Nevertheless, this occurrence does show that Ex-AR3664 is still likely a very active feature prone to producing fast CMEs.

Solar Wind / Geomagnetic Activity: Background to slightly elevated solar winds speeds were observed by ACE at L1, varying between 350-450 km/s, with below average density. The Interplanetary Magnetic Field (IMF), Bt, was generally weak, around or below 8nT, with the north-south component, Bz, also weakly varying between +6nT and -6nT. Phi angle was mainly positive (away from the Sun). Geomagnetic activity was Quiet (Kp 1-2).

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 (greater than 10 MeV) remained at Background. High energy electron flux (greater than 2MeV) at GOES16 remained at Background to Moderate levels. Associated 24-hour fluence remained below the Active threshold. Observed fluence at 27/0000 UTC was 5.93e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: High activity is expected, M-flares are expected going forward with a chance of isolated X-flares. This risk is predominately from ex-AR3664 which is anticipated to rotate onto the visible disc within the next 24 hours, but also from AR3691 in the northwest.

Solar Wind / Geomagnetic Activity: There is a possibility of weak CME glances, initially from a filament eruption on the southeast disc on May 23, and potentially later from a filament eruption on the southwest disc early on May 27. However, both events are considered very unlikely to have significant impact. Weak fast wind influences are also possible, most likely day 1 and into day 2 (27-28 May) from the southern coronal hole CH40/+. Otherwise mainly background slow wind conditions are anticipated.

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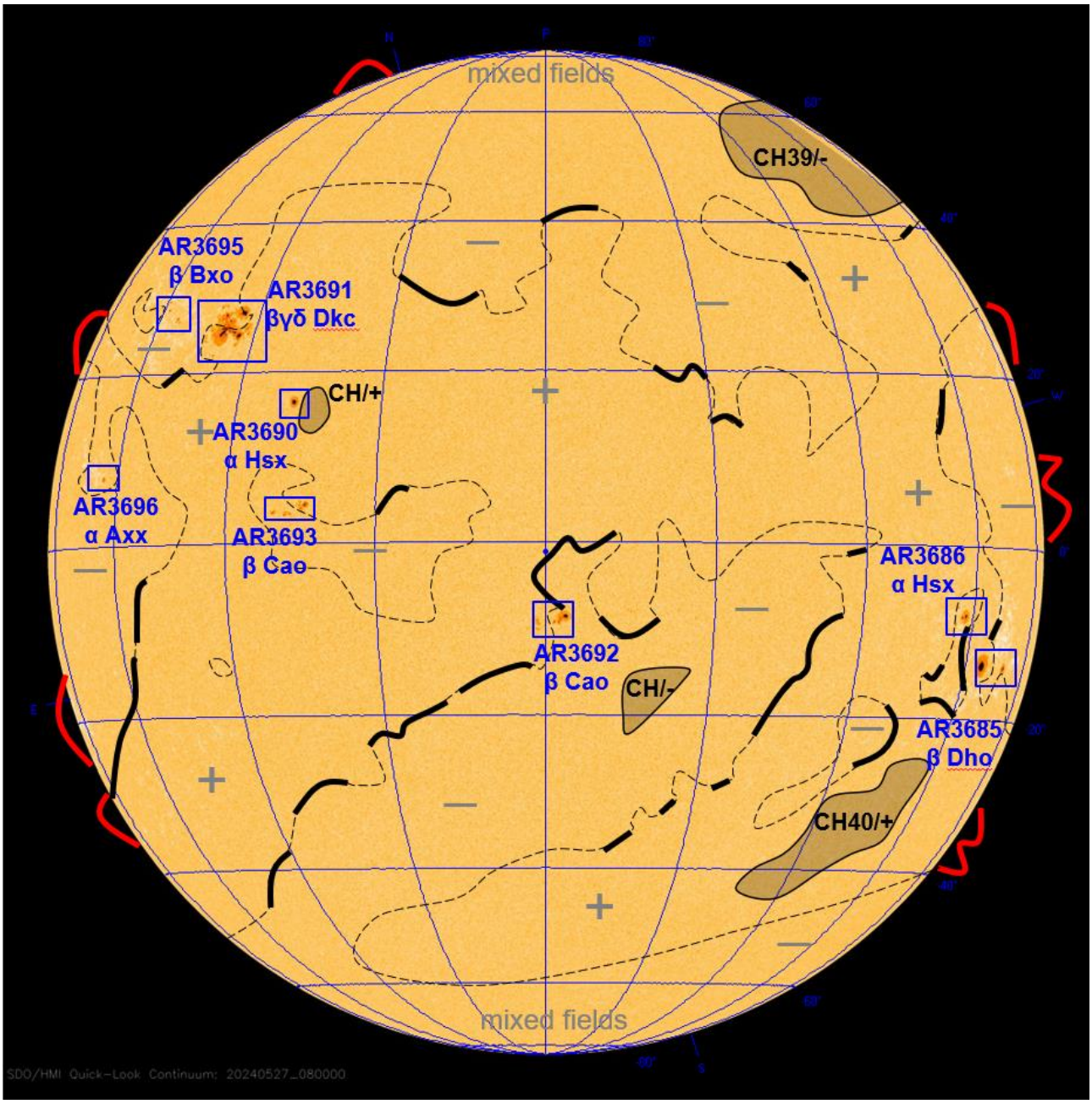
Met Office Space Weather Technical Forecast

Mainly Quiet to unsettled geomagnetic activity is expected, perhaps rising to give spells of active conditions at times, but with only a very slight chance of G1 Minor Storm with any coronal hole onset or unlikely CME arrival.

Energetic Particles / Solar Radiation: High energy proton flux is expected to be at background throughout. High energy electron flux is also forecast to persist at mainly background, The associated 24 hour fluence is expected to remain well below Active.

Figure 1. Solar Analysis Valid 27/0800.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

A weak CME which left the Sun due to a filament eruption around 23/0600 UTC, had the potential to give us a glancing blow early on the 27th May, this was a fairly low confidence CME due to its weak nature and contaminated imagery. It has yet to arrive at Earth and now seems unlikely to do so. Additionally, a filament eruption to the southwest occurred around 27/0150 UTC, producing a narrow CME that is currently undergoing ENLIL analysis. However this CME is unlikely to have an Earth-directed component.

Otherwise, mainly background solar winds are expected to continue although some slight enhancements may occur in association with CH40/+ situated in the southern disc into Day 1 or Day 2 (27-28 May), although any such enhancement is both low confidence and likely be limited, with solar winds quickly returning to background.

Mainly Quiet to unsettled geomagnetic activity is expected, perhaps rising to give spells of active conditions at times, but with only a very slight chance of G1 Minor Storm with any coronal hole onset or unlikely CME arrival.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	5	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
23/1553	23/1553	23/1553	23/1553	23/1553	23/1553	23/1553

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Radio Blackouts - X-Ray Flares:

High activity is expected, M-flares are expected going forward with a chance of isolated X-flares. This risk is predominately from ex-AR3664 which is anticipated to rotate onto the visible disc within the next 24 hours, with its magnetic canopy and associated magnetic looping visible in SDO imagery. The region remains active and has already produced an X-flare from over the southeast limb at 0708 UTC this morning, accompanied by a broad, fast, CME from over the eastern limb. Analysis of the region, once it rotates onto the visible disc, will be necessary to determine if it has retained its full complexity from last rotation. During its previous rotation, AR3664 was highly active and produced several X-flares.

Of the eight sunspot regions currently on the visible disc, AR3691 in the northwest is the most complex and also contributes to the flare risk. The region is also likely Ex-AR3663, an active region from last rotation, although the region appears smaller than its previous incarnation. AR3691 comprises of two delta spots: a large one at its centre and a smaller one to the northwest and extensive magnetic looping is evident in SDO imagery. Across the rest of the disc, the regions remain smaller and simpler by comparison.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	90	90	90	90
Very Active	R3 to R5 X Class	Yes	40	40	40	40

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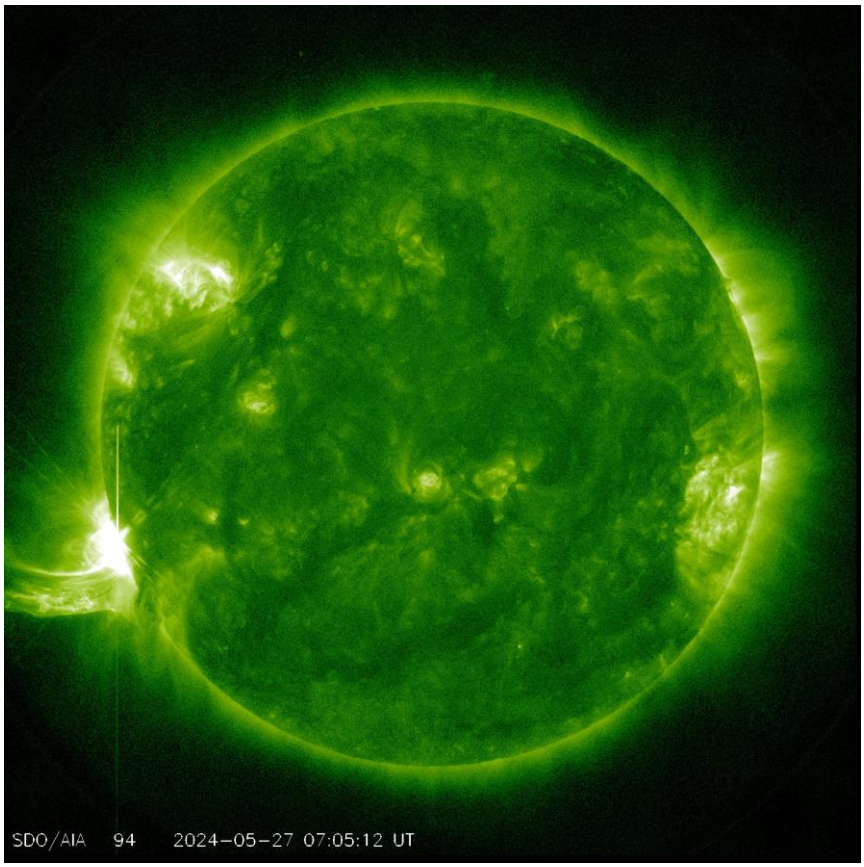
Figure 2: X-ray Trace from GOES16/18, showing X2.8 flare at 0708UTC this morning from over the southeastern limb, likely in association with Ex-AR3664.

Figure 3: SDO/AIA 94 imagery valid 27/0705UTC showing flare from southeastern limb.



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Solar Radiation Storms - (High Energy Protons):

GOES-18 proton flux is currently at background, and is currently expected to persist at these levels through the period. Ex-AR3664, over the southeastern limb, and AR3691, to the northwest of the disc, are the regions most likely to cause larger flares. However, both regions will be in non geo-effective locations for a proton response in the coming days. Despite this, due to the propensity of EX-AR3664 for larger flares, the risk is maintained above background levels.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

GOES-16 electron flux is currently mainly background with only brief diurnal increases to Moderate possible. There is a slight chance of a weak connection to CH40/+ day 1-2 (27-28 May), perhaps further suppressing the electron population at GEO on onset, with little enhancement following.
The associated 24 hour electron fluence is expected to remain below the Active level, as supported by MOSWOC REFM, which is currently providing good guidance for the expected trend.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^{8}$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^{9}$**	No	1	1	1	1

Figure 4: Latest MOSWOC REFM output.

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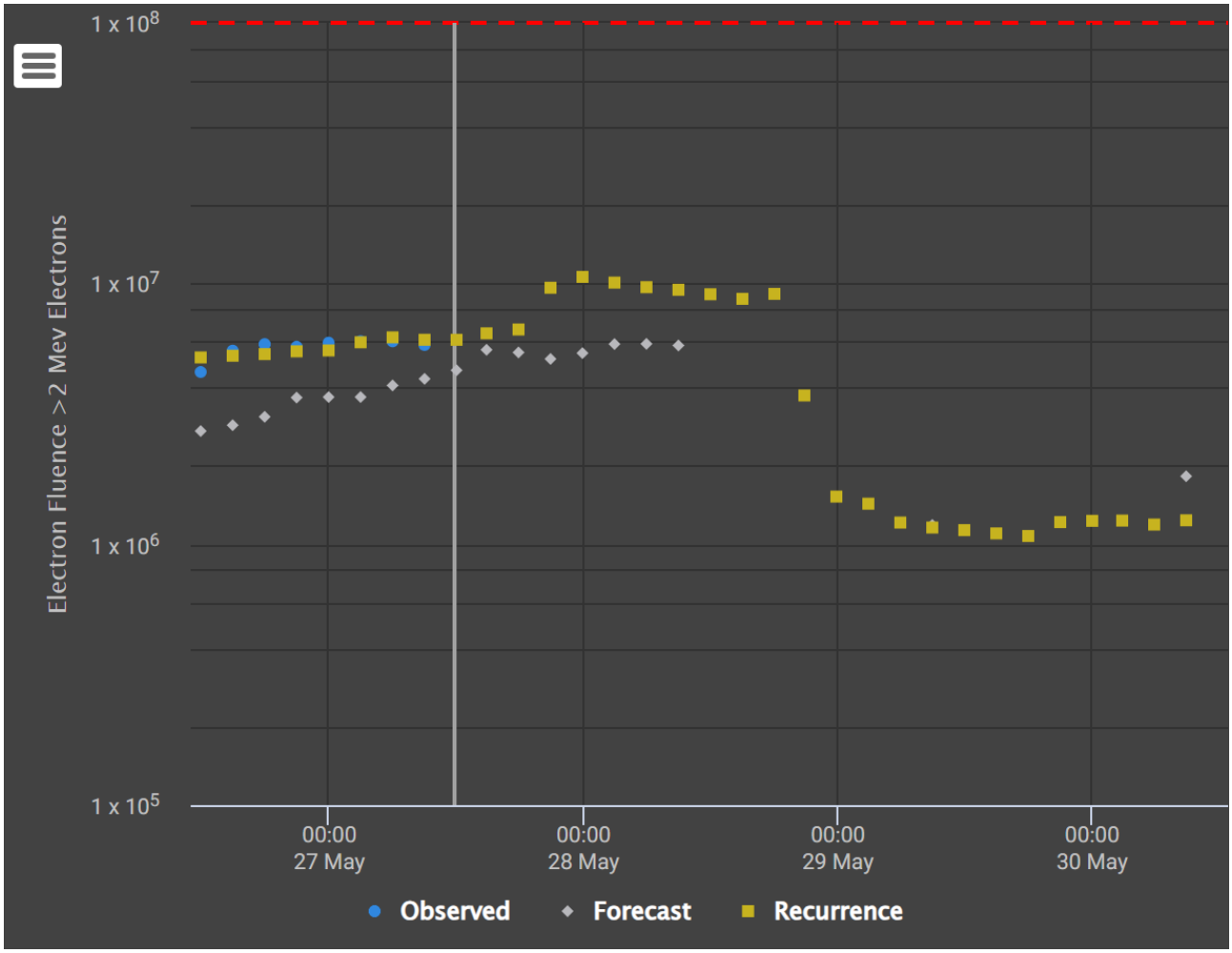

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